

Lung toxicity testing of inhalable ultra fine particles by the Karlsruhe Exposure System

Mülhopt, Sonja¹, Diabaté, Silvia², Weiss, Carsten², Seipenbusch, Martin³,
Schlager, Christoph¹ and Paur, Hanns-Rudolf¹

KIT – Karlsruhe Institute of Technology

¹Institute for Technical Chemistry, Thermal Waste Treatment Division

²Institute of Toxicology and Genetics,

³Institute for Mechanical Engineering and Mechanics,
76344, Eggenstein-Leopoldshafen, Germany

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Epidemiological studies show an association between the concentration of fine and ultrafine particles (PM10, PM2.5, PM0.1) in the atmosphere and the rate of mortality or morbidity due to respiratory and cardiovascular disease. Assessment of the risk of airborne nanoparticles in workplaces or other ultra fine particle exposed atmospheres is therefore an urgent task. The causes of the toxicological effects of ultra fine and nanoparticles to the human organism are yet unknown. Besides the chemical composition, physical properties of the particles as BET for example seem to be of particular importance for the effects. For the quantitative assessment of the toxicity of airborne particles the dose – response relationship is tested using in vitro test systems employing bioassays of cell cultures as sensor (Paur et al.).

The Karlsruhe Exposure System was developed for the air-liquid interface exposure of cell cultures towards aerosols. This system consists of an isokinetic sampling unit to collect the aerosol from the particle loaded atmosphere passing a size selective inlet. The aerosol is humidified and directed into VITROCELL exposure modules containing three Transwell inserts with human lung cells. The aerosol flows perpendicular onto the surface of the cell culture depositing the particles on them. The responses of the cells were analyzed by measuring the viability (LDH, AlamarBlue) as well as the release of Interleukin-8 (IL-8) as a marker for pro-inflammatory changes (Diabaté et al.).

For the determination of the dose response relationship the accurate knowledge of the dose is an essential question. A newly developed method is installed at the Karlsruhe Exposure System: the deposited mass per area unit is monitored by a quartz crystal microbalance as a function of exposure time showing a linear relationship for a constant aerosol flow with defined particle concentration.

Platinum particles as used in automotive catalysts were tested for toxicity. Platinum nanoparticles were generated by a spark discharge

generator, the aerosol with a number concentration of $6 \cdot 10^6$ 1/cm³ had a modal diameter of 28 nm and a standard deviation of σ_g of 1.4 (Figure 1). Exposure experiments with human lung cells are still ongoing.

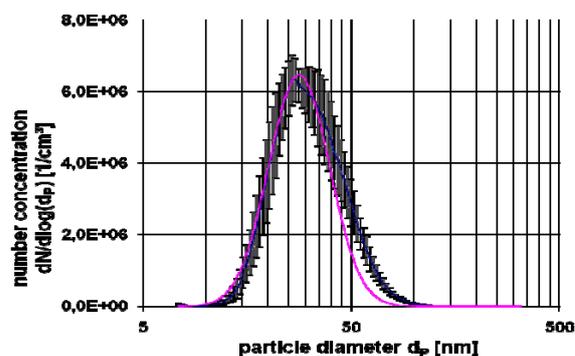


Figure 1. Particle size distribution of platinum nanoparticles in the Karlsruhe Exposure System determined by Scanning Mobility Particle Analysis (SMPS 3934, TSI)

The Karlsruhe exposure system and the lung specific bioassay are an appropriate tool to screen the biological effects of different industrial particles directly in the particle loaded atmosphere. The new online measurement of the deposited mass in dependence of time provides a direct control of the behaviour of the exposure parameters like aerosol concentration.

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Diabaté, S., Mülhopt, S., Paur, H.-R., Krug, H.F. (2008) *Alternatives To Laboratory Animals* 36, 285

Paur, H.R., Mülhopt, S., Diabaté, S., Weiss, C. (2008) *Journal für Verbraucherschutz und Lebensmittelsicherheit* 3, 3, 319-329